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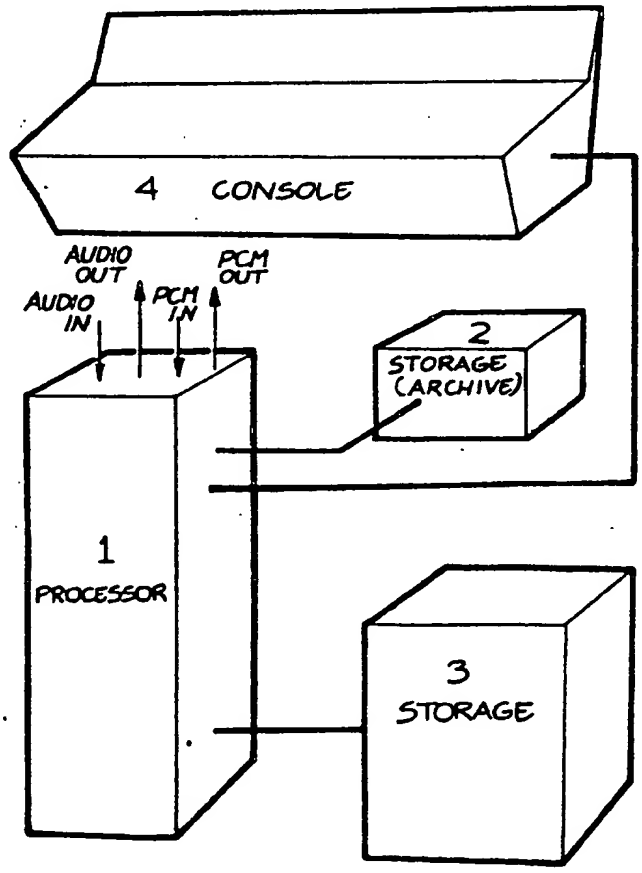
(54) Title: CONTROL SYSTEM

(57) Abstract

A control system for the manipulation of sounds, when playing or recording said sounds, said system monitoring one or more inputs representative of the status of hardware transducers, and converting one or more of said inputs into digital input form, and storing said digital input in storage means (2, 3) associated with a time reference generated by a time reference means, (1) said system being adapted to recall and display said digital input on visual display means, (4) and allow manipulation of said digital input by direct interaction with said visual display or by remote interaction means, said manipulation optionally being a further input and/or an output to said hardware transducers.



CONTROL SYSTEM

The present invention relates to a control system and particularly an automated system for the sound engineer mixing sounds recorded on separate tracks or channels of a multi-track tape or other recording medium.

The combining or mixing of sound components in an aurally balanced way can be achieved by manipulations such as switching each track (channel) on or off as required and thereby minimizing noise from that channel, altering the volume of each track to achieve the desired balance, and optionally manipulating the sound through synthesizers, such as, for example mutes.

The most common apparatus used for this process is a console containing an array of potentiometers, known as faders, that alter the voltage applied to a voltage controlled amplifier and thus the sound volume from that amplifier, and also the voltage applied to synthesizers to alter the nature of the sound.

There is one main fader for each track of sound, and by switching the main fader into or out of the circuit one also has control of the presence of any track in the final mix.

According to early forms of the prior art, a multi-track tape is replayed and re-recorded on a second tape, the presence, nature, and volume of any one or more individual tracks being altered during the replaying so that the changes form part of the second tape recording.

Disadvantages with this method of operation were that it requires and uses a second or more tapes, and because change is made as at the same time as re-recording, there was a need to do the change correctly the first time. As it was difficult, if not impossible, to alter all the tracks requiring change in any single taping, it was necessary to continue with further re-recordings. It was a further disadvantage with this procedure that it was not easy to tell if the maximum amplification and/or maximum synthesized manipulation of any track had been reached or

was near. Further, physical movement across the console to alter the faderscauses the engineer to move away from the central position required for best perception of stereo sound effect.

To try and overcome some of these disadvantages, further developments in the prior art have included the addition of motors to each fader so that the manipulation of any particular track could be seen and compared to the maximum available gain for any fader.

This, however, has still had the disadvantage of requiring an engineer to be responsible for overseeing the whole console and having to move away from central position. This system has also involved numerous tape re-recordings.

Most recent developments in the prior art have utilised a hardware key pad (micro-processor board) that allows an engineer to operate the console from a central position, the introduction of a memory noting the changes made in any track with respect to a clock reference (time code) and recalling the changes made as required.

Disadvantages with this system still exist, however, in that the operator is restricted to the logic of the pre-programmed hardware key pad and is still not readily able to determine whether the maximum gain of a particular fader has been reached or likely to be exceeded.

There is need for an operator to physically interact with the recording console. Further, the operator must still have high mixing skill levels even with these recent developments.

Towards overcoming the above disadvantages, there is provided according to the present invention, a control system for the manipulation of sounds, when playing or recording said sounds, said system monitoring one or more inputs representative of the status of hardware transducers, and converting one or more of said inputs into digital input form, and storing said digital input in storage means associated with a time reference generated by time reference means, said system being adapted to recall and display said

digital input on a visual display means, and allow manipulation of said digital input by direct interaction with said visual display means or by remote interaction means, said manipulation optionally being a further input and/or an output to said hardware transducers.

In a preferred embodiment of the invention there is provided in association with said digital input, input identifying means, said input indentifying means being optionally recalled and displayed with the recall and display of the associated digital input.

The control system connects hardware transducers such as amplifiers, synthesizers and multitrack recorders to a programmable computer. The connection as such to a fader console is optional and not strictly necessary.

Inputs from the hardware transducers are representative of their working status, for example, the voltage levels of voltage controlled amplifiers as stated above. The inputs are monitored by the computer of the control system scanning the inputs at a rate substantially faster than any change in hardware status whilst allowing for the storage of the hardware statuses.

Conversion of the inputs into digital form is preferably via a bus structure.

Storage of the input information is preferably in the memory of the computer on conventional floppy disc.

The time reference means is preferably a clock oscillation generated and controlled by the computer, synchronizing the position of a manipulation of sound within the overall musical piece.

The input identifying means comprises information preferably associated with a sequence of inputs, to identify those inputs as forming a particular passage or mix within a musical piece. Identification can preferably also include information on the musician or vocalist, the instrument(s) and any other indicia that assist in identifying the particular passage or track over earlier mix attempts.

The visual display means is preferably a screen, said screen displaying input information preferably by graphical and/or colour means such that, when applicable, the maximum possible manipulation is also indicated. The screen display is preferably designed to display the input information in conjunction with input identifying means, as described above, so that the user of the system has visually before him all the information required to adequately control the mixing process.

Preferably in association with said display is an indication of time from the time reference means.

The direct interaction with said visual display means is preferably by the user touching the screen. The remote interaction means preferably includes a mouse, light pen or other key pad device to alter the visual display.

It can be seen from all of the above, that the invention has the advantages of providing a system which combines mass storage techniques and analog digital, digital analog conversions, extensive processing power and screen graphics to emulate the complete recording process.

The use of computer processing gives the further advantage of use of software menu type displays to assist in the use of the system through all the necessary stages in the sound mixing process or operation. A preferred embodiment of the invention will be described with reference to the accompanying figures:

Figure 1 is a physical layout of control system;

Figures 2a, 2b and 2c show alternative block circuit diagrams describing more fully the inputs and electronic connections between main parts of the control system;

Figures 3 is a screen display interface with studio tape transport hardware.

Figure 4 is a tabulation of standard steps in the production of a final mix.

Referring to Figure 1, there is shown a processor 1 with storage facilities 2 and 3 for long term (archive) and fast access mass storage respectively, connected to the control system console 4.

Hardware transducer inputs, conversion into digital input and outputs of whatever nature are controlled by the processor 1 via the control system console which preferably is in the form of a flat T.V. type screen or screens displaying information in a manner shown by way of example in Figure 3. The screens are preferably of the touch control type and may contain a window function enabling different types of displays to be simultaneously shown on the console on any one screen.

Referring next to Figures 2(a), (b) and (c), the block diagrams depicted outline the connections between the main parts of the control system. It can be seen that the system operates through an external bus structure with, referring to Figure 2(a), studio inputs entering from a switch interface board and analog digital analog board to the main central processing unit. The time code generator is also connected to the production studio and the external bus structure via an input/output port board. Following manipulations, outputs pass through an input/output port board and a lead interface board.

The use of the control system is preferably by way of command functions set up within a number of standard format type screen displays not shown.

The various operations associated with the sound mixing process include recording, playback, alteration, muting and focusing on specific passages of music for appropriate manipulation. These operations have been given command function names in the control system such as write, read, update, solo write, mute, with enter and leave commands for moving through each function together with a execute and clear command function.

These command functions enable easy operation of the control system assisted by a help function and menu displays which direct the user when the need arises.

The use of the command functions is further described with reference to Figure 4 which shows a typical sequence of functions for operating the system in creating a mix.

In operation, a sequence of sounds, such as music, is recorded with respect to a time code. Any changes to the sound made by the sound engineer is inputted into the control system against a time code reference being either real time or time with respect to the musical piece as a whole by storing the degree of change as a digital quantity against the time reference. This can be referred to as a first mix.

In the case of a fader adjustment, the change in voltage is stored and not the change in the sound of the music as has been the case in the prior art.

Playback of the sound will include the changes made by the sound engineer as the processor monitors the information in its storage and repeats the changes occurring at each time point.

Accordingly, the system provides the advantage of playback of the new mix without the need for any further recording of the sound on tape until the mix has been finished to the satisfaction of the sound engineer.

This first mix can be referred to as a mix file and subsequent manipulators will generate a new mix file as changes made by the sound engineer are stored. Old mix files are not discarded unless specifically deleted and pecific sounds such as solo pieces or specific time intervals of music can be manipulated and entered into the mix (ie. a master mix file) as required.

Each mix file can be given a title and the title stored on a menu for recall purposes.

Updating the mix can be effected by executing commands such as (PLAY) (JOIN) (MIX) A (FROM) (time) (EXECUTE), or for example, (GO TO) (JOIN) (MIX) (AT) (CUE) (title such as solo) (EXECUTE). Refer again to Figure 5.

The cue function enables a specific point in a musical score to be reached by identifying that point as a cue or by a title rather than by a specific point in time.

Referring to Figure 4, one of the screen displays shows bar graphs, preferably in colour, representing amplifier level information. Fader adjustments, grouping of various tracks and muting can all be executed by direct screen control of the bar graphs. Preferably the bar graphs will change colour as they each approach the maximum voltage of the respective amplifiers so that a further visual cue is provided to the sound engineer monitoring the mix.

By using any form of cursor pointer device such as a mouse or by directly touching the screen any channel levels of the console may be adjusted. In the same manner channels may be grouped together to allow one or more channels to be adjusted for level with the one movement from the system operator.

This form of interaction between the screen and the hardware may also be used to allow any channel to be soloed, muted, dynamics adjusted, equalisation of any channel to be adjusted and any adjustment effecting the processing of signals through the recording console.

With specific reference to the screen display of Figure 3, this display is typical of many of the screens and represents "graphic" buttons which interface with hardware and directly control equipment positioned around the recording facility. With this screen the computer can control all the necessary functions on studio tape transports, while the other screens cover control of other studio equipment.

By either directly touching the screen, or using the mouse to to point to the required control function, the operator of the system can directly access these functions.

By inserting the computer into this control path the advantages of automating control are realised along with storing and recalling of complex control sequences and all with one action selection.

The modular nature of the control system provides the advantages of utilizing all hardware transducers in a studio environment and possibly upgrading their functioning by means of the programmable processor.

A further advantage of the system is the ability to effect maintenance by on-line modem interconnection to a remote maintenance team able to investigate and correct problems.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A control system for the manipulation of sounds, when playing or recording said sounds, said system monitoring one or more inputs representative of the status of hardware transducers, and converting one or more of said inputs into digital input form, and storing said digital input in storage means associated with a time reference generated by time reference means, said system being adapted to recall and display said digital input on a visual display means, and allow manipulation of said digital input by direct interation with said visual display means or by remote interaction means, said manipulation optionally being a further input, and/or an output to said hardware transducers.

2. A control system as claimed in claim 1 wherein input identifying means are provided in association with said digital input, said input identifying means being adapted to be recalled and displayed with the recall and display of the associated digital input.

3. A control system as claimed in claim 1 or claim 2 wherein said hardware transducers namely amplifiers, synthesizers and multitrack recorders are connected to a programable computer.

4. A control system as claimed in any preceding claim wherein the connection is also made to a fader console.

5. A control system as claimed in any preceding claim wherein the inputs from the hardware transducers are representative of their working status, for example the voltage levels of voltage controlled amplifiers.

6. A control system as claimed in any preceding claim wherein the computer monitors the inputs at a rate substantially faster than any change in hardware status whilst allowing for storage of said hardware status.

7. A control system as claimed in any preceding claim wherein the time reference means is a clock oscillator generated and controlled by said computer synchronising the position of a manipulation of sound within the overall musical piece.

8. A control system as claimed in any preceding claim wherein the input identifying means includes information associated with a sequence of inputs to identify those inputs as forming a particular passage or mix within a musical piece.

9. A control system as claimed in any preceding claim wherein the visual display means is a screen, said screen displaying input information by graphical or colour means such that the maximum possible manipulation is indicated.

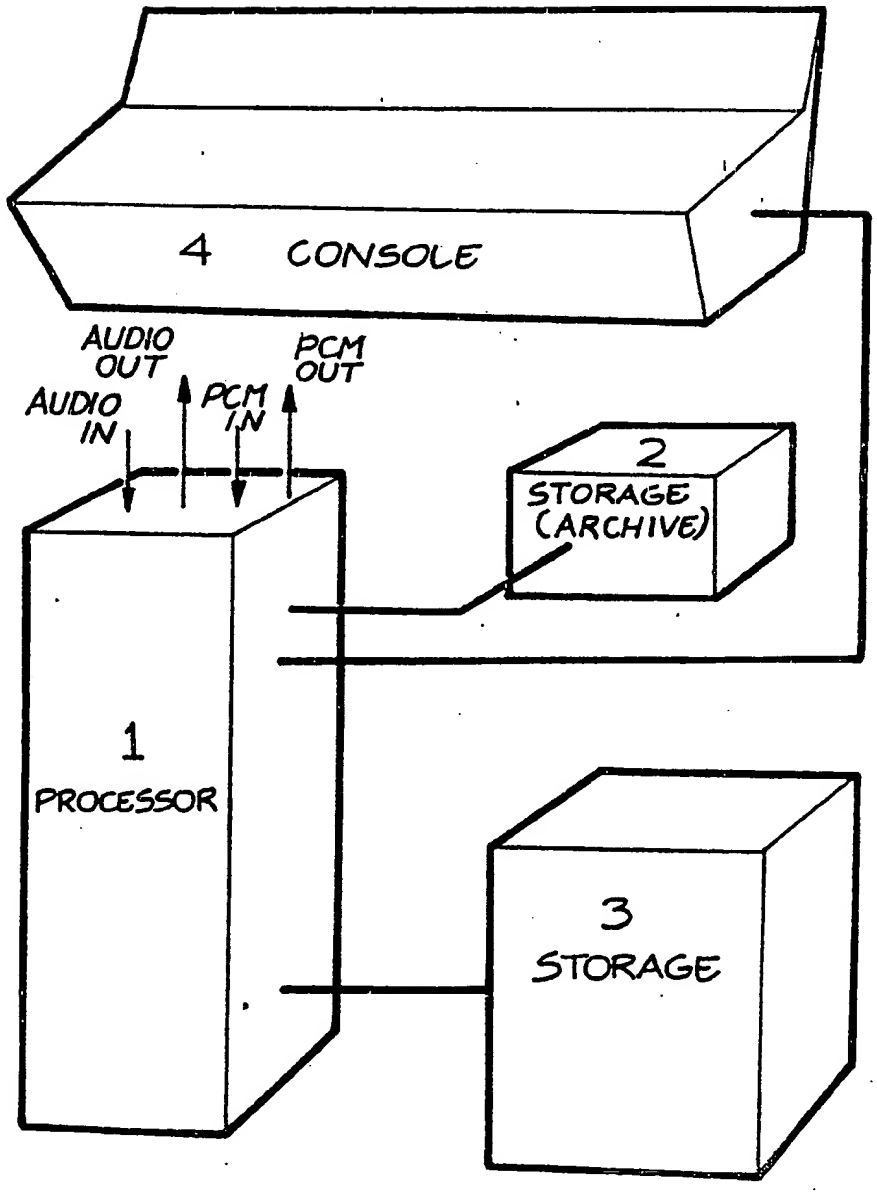

4 CONSOLE
AUDIO OUT
PCM OUT
AUDIO IN
PCM IN
2 STORAGE (ARCHIVE)
1 PROCESSOR
3 STORAGE

FIG.1

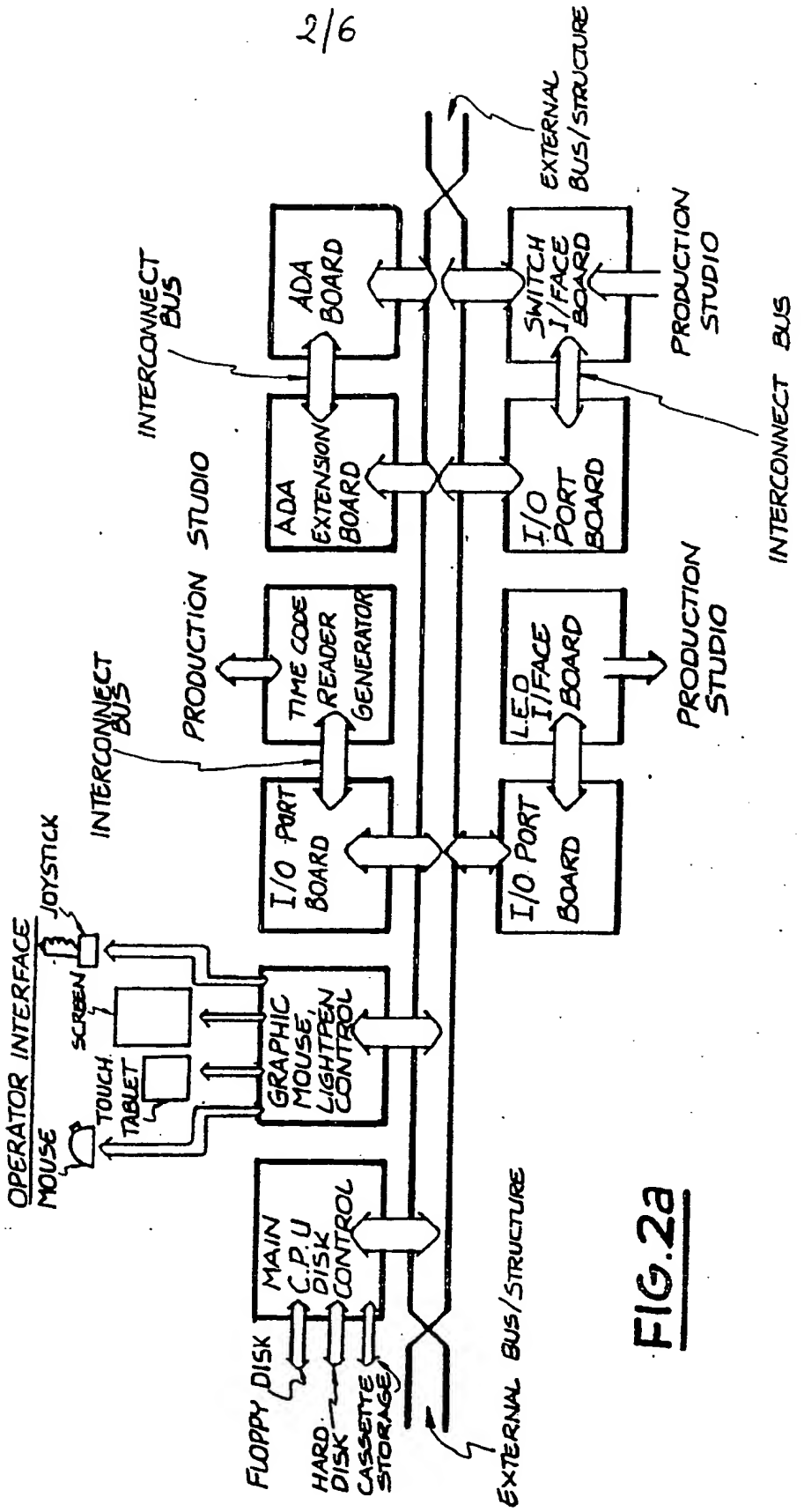

OPERATOR INTERFACE
MOUSE
TOUCH TABLET
SCREEN
JOYSTICK
GRAPHIC MOUSE, LIGHTPEN CONTROL
INTERCONNECT BUS
PRODUCTION STUDIO
TIME CODE READER GENERATOR
I/O PORT BOARD
INTERCONNECT BUS
PRODUCTION STUDIO
ADA EXTENSION BOARD
ADA BOARD
INTERCONNECT BUS
PRODUCTION STUDIO
I/O PORT BOARD
L.E.D I/FACE BOARD
I/O PORT BOARD
SWITCH I/FACE BOARD
EXTERNAL BUS/STRUCTURE
FLOPPY DISK
HARD DISK
CASSETTE STORAGE
MAIN C.P.U DISK CONTROL
EXTERNAL BUS/STRUCTURE

FIG.2a

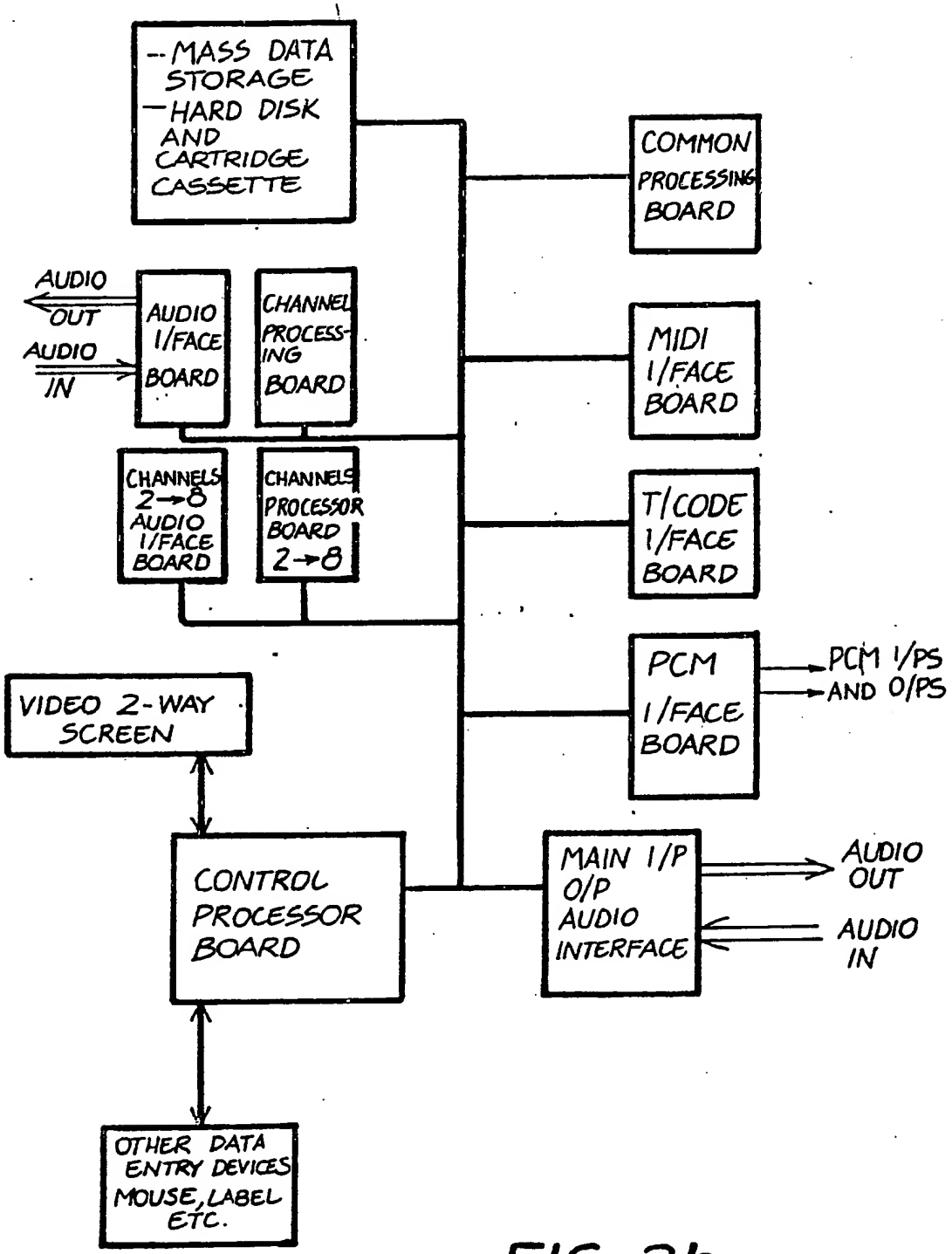

--MASS DATA STORAGE
—HARD DISK AND CARTRIDGE CASSETTE
COMMON PROCESSING BOARD
AUDIO OUT
AUDIO IN
AUDIO I/FACE BOARD
CHANNEL PROCESS-ING BOARD
MIDI I/FACE BOARD
CHANNELS 2→8 AUDIO I/FACE BOARD
CHANNELS PROCESSOR BOARD 2→8
T/CODE I/FACE BOARD
PCM I/FACE BOARD
PCM I/PS AND O/PS
VIDEO 2-WAY SCREEN
CONTROL PROCESSOR BOARD
MAIN I/P O/P AUDIO INTERFACE
AUDIO OUT
AUDIO IN
OTHER DATA ENTRY DEVICES MOUSE, LABEL ETC.

FIG. 2b.

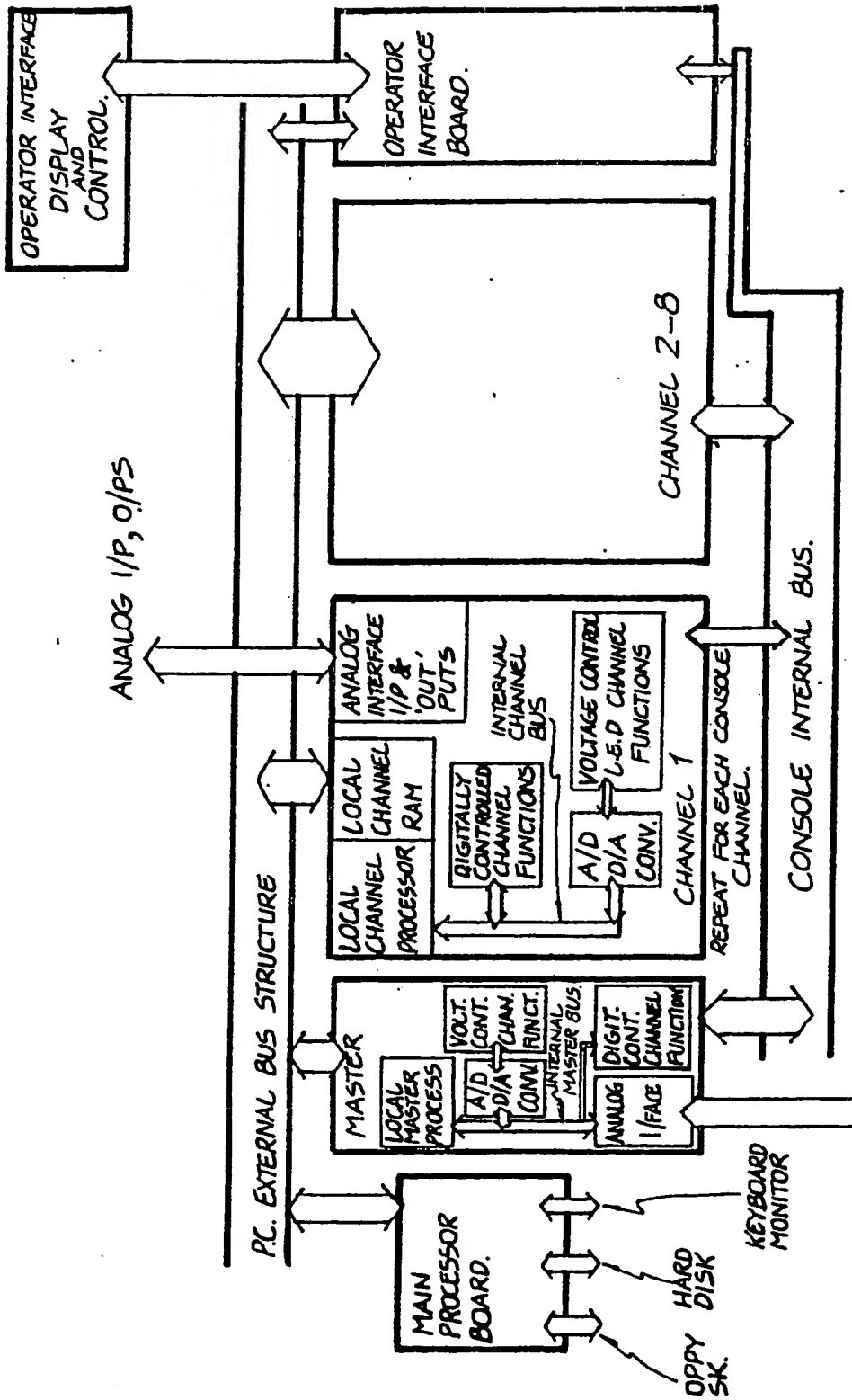

OPERATOR INTERFACE DISPLAY AND CONTROL.
OPERATOR INTERFACE BOARD.
CHANNEL 2-8
ANALOG I/P, O/PS
ANALOG INTERFACE I/P & 'OUT' PUTS
INTERNAL CHANNEL BUS
VOLTAGE CONTROL U.E.D CHANNEL FUNCTIONS
LOCAL CHANNEL RAM
LOCAL CHANNEL PROCESSOR
DIGITALLY CONTROLLED CHANNEL FUNCTIONS
A/D D/A CONV.
CHANNEL 1
REPEAT FOR EACH CONSOLE CHANNEL.
CONSOLE INTERNAL BUS.
P.C. EXTERNAL BUS STRUCTURE
MASTER
LOCAL MASTER PROCESS
A/D D/A CONV.
VOLT. CONT. CHAN. FUNCT.
INTERNAL MASTER BUS.
DIGIT. CONT. CHANNEL FUNCTION
ANALOG I/FACE
ANALOG I/PS, OPS
MAIN PROCESSOR BOARD.
KEYBOARD MONITOR
HARD DISK
OPPY SK.

FIG.2c.

FIG.3

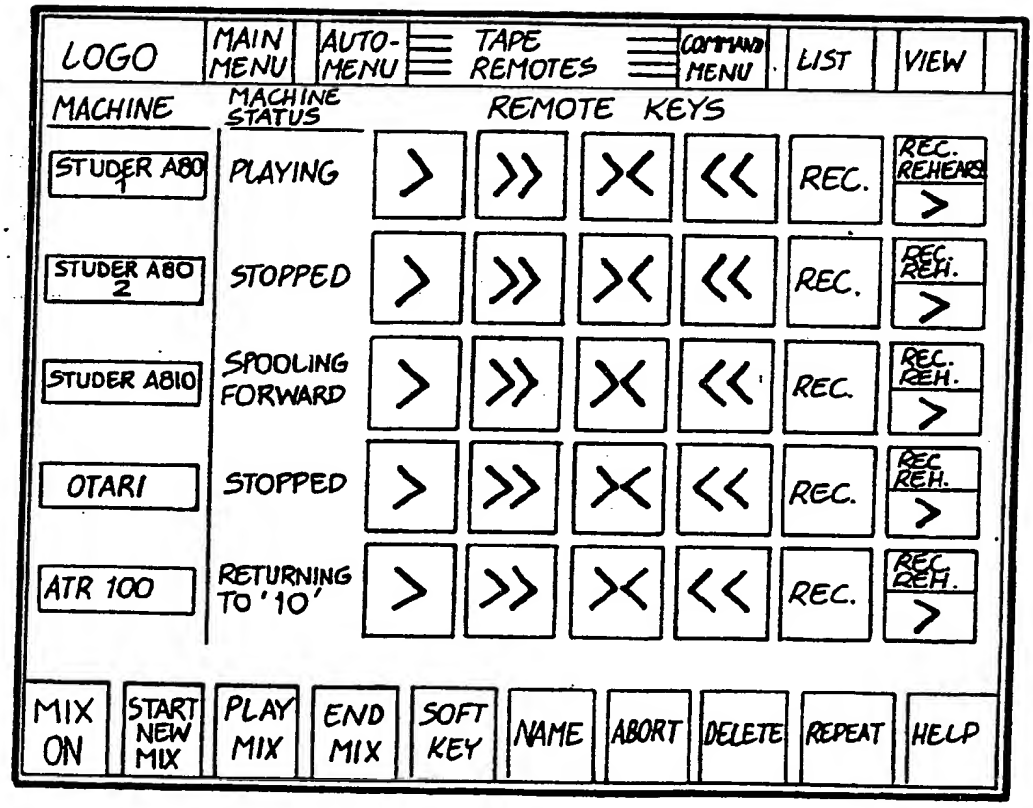
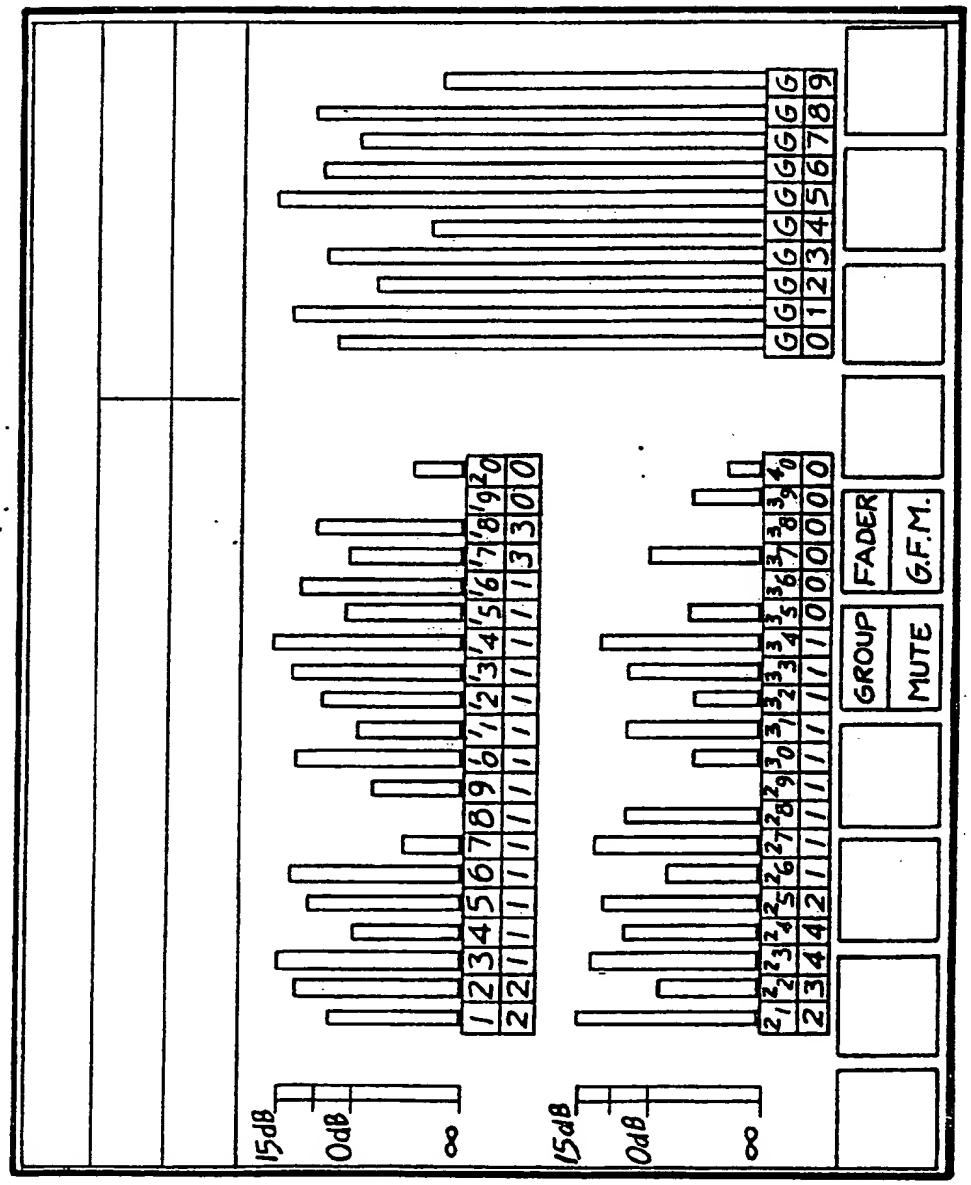

LOGO
MAIN MENU
AUTO-MENU
TAPE REMOTES
COMMAND MENU
LIST
VIEW
MACHINE
MACHINE STATUS
REMOTE KEYS
STUDER A80 1
PLAYING
REC.
REC. REHEARS
STUDER A80 2
STOPPED
REC.
REC. REH.
STUDER A810
SPOOLING FORWARD
REC.
REC. REH.
OTARI
STOPPED
REC.
REC. REH.
ATR 100
RETURNING TO '10'
REC.
REC. REH.
MIX ON
START NEW MIX
PLAY MIX
END MIX
SOFT KEY
NAME
ABORT
DELETE
REPEAT
HELP

FIG.4



INTERNATIONAL SEARCH REPORT

International Application No PCT/AU 87/00349

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [5]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[4] H04H 7/00, G11B 27/02

II. FIELDS SEARCHED

Minimum Documentation Searched [6]

Classification System	Classification Symbols
IPC	H04H 7/00, G11B 27/02

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [6]

AU : IPC as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [7]

Category [8]	Citation of Document, [10] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	GB,A, 2096868 (AMPEX CORP) 20 October 1982 (20.10.82)	
A	GB,A, 1387286 (CBS INC) 12 March 1975 (12.03.75)	
A	US,A, 3932886 (OLMS et al) 13 January 1976 (13.01.76)	
A	Patent Abstracts of Japan, 84-P, page 17, JP,A, 55-52565 (TEAC K.K.) 17 April 1980 (17.04.80)	

* Special categories of cited documents: [9]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of the International Search Report
16 December 1987 (16.12.87)	(12.01.88) 12 JANUARY 1988
International Searching Authority: Australian Patent Office	Signature of Authorized Officer: pp. A.W. DUKE

Form PCT/ISA/210 (second sheet) (January 1985)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON
INTERNATIONAL APPLICATION NO. PCT/AU 87/00349

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Members		
GB 2096868	AU 81070/82	CA 1177969	DE 3213036
	FR 2509075	JP 57178532	NL 8201110
	SE 8202264	US 4521870	

END OF ANNEX